A NOVEL ANALYTICAL APPROACH FOR THE PROTECTION OF THE WIRELESS NETWORK

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Abstract: A novel analytical approach for the protection of the wireless network which may be used for the collection of data on the health of the transmission line is demonstrated in this paper. In present paper, we presented an error free secure wireless communication network security using distributed key management scheme based on several IP technologies, cryptographic method such as asymmetric public key cryptosystem. We used, Ordeal Random Data Encryption System (ORDES), fault detection method, cheater identification and verifiable secret sharing which will further increase the usability of communication channel and facilitate error less delivery of the data on wireless network.

Keywords: Wireless; network, communication; security

INTRODUCTION

With the current economic growth, the need for power is continuously increasing. Currently, there are several efforts to provide high-quality power in various fields are going on world wide [1]. With this trends research works into the diagnosis of high voltage equipment are actively being performed to discover fault symptoms and to analyze the faults in order to not allow the same fault in the future [2]. Most of the monitoring and analysis are done for the insulators and power lines [3]. Insulator are used to isolate the naked power lines and to support the lines mechanically [4]. There are several tools and methods used to detect the faults in the transmission line which can be categorized as: thermal imaging cameras [5], human eyes, electric fields, corona cameras, neon lamp methods [6] and knowledge based approaches such as deployment of Sensors on the transmission tower [9]. Since there are variety of malfunction and fault may occur at the transmission line, the inspection needs to be done without stopping the power transmission. Currently most of the inspections are done periodically for each electric tower relying on human visual detection by an expert in the task [7], [8].

This is real situation with low efficiency, reliability and high risk inspection [4]. To prevent the accident and to improve the inspection reliability, it is the time to replace the human operators with inspection robots which can collect the data on the heath of transmission line [4]. This may lead to reduce the Electric power transmission and distribution losses (% of output) in India was 24.45 as of 2009. Its highest value over the past 38 years was 28.65 in 2001, while its lowest value was 16.36 in 1971. Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage [10]. Technology development in sensors, robotics, unmanned vehicle, satellite and wireless communication could be leveraged to enable the development of an effective automatic inspection system for transmission line/ tower monitoring applications. The system concept was defined based on the sensing needs such as system tempering due to terrorism, manmade encroachment, vegetation encroachment, gun shot at insulators, lightning etc. by deploying the various sensor as per the need on the instrumentation facility provision on power utility towers [9]. The data communication on various parameter of health of the transmission line will rely on wireless/fiber optic technology. This data may be collected by the “Central data base” directly from the sensor/Hub wirelessly using: RF mode; via Satellite or cell phone network, unmanned airborne vehicle (UAV), manned aerial vehicle, “line crawler” Robot traveling the length of the line [9].

In a wireless network, data are transmitted through an open space and any node in the coverage area can receive the radio signals. Moreover, in Wireless mesh networks (WMNs), the external environment can be much harsher due to the lack of central administration [11]. Security is a crucial and urgent problem in a wireless network as now a days the activity of unlawful event is happening in every part of the world and security of the transmission line is also a great concern for the nation. The present paper focused on the development of security system in wireless network using data cryptography technique. We are working on the security of a system which constitute Central data base” i.e. commander and a data collection vehicle (sensor, UAV, MAV, Robot), the all conversation between Commander and date collection vehicle (sensor, UAV, MAV, Robot) to be held within the complete secure system so that unauthorized access to be neglected.

Bit commitment from any one-way function: one can create a bit commitment scheme from any one way function. The scheme relies on the fact that every one-way function can be modified to possess a computationally hard core predicate. Let w be a one way function, with j a hard core predicate. Then to commit to a bit e Participant picks a random input t
and sends the triple \((j, \omega(t), e^j(t))\) to robot where \(+\) denotes XOR, i.e. addition modulo2. To decommit Participant simply sends \(t\) to robot. This scheme is concealing because for robot to recover \(e\) he must recover \(j(t)\). Since \(j\) is computationally hard core predicate, recovering \(j(t)\) from \(\omega(t)\) with probability greater than one-half is as hard as inverting \(\omega\). The scheme bindingness depends greatly on whether or not \(w\) is injective.[13,14,15]

If participant wants to commit to some message \(m\) he just put in to the sealed envelope, so that whenever participant want to reveal the message to Robot, he opens the envelope. First of all the digital envelope should hide the message from: Robot should be able to learn \(m\) from the commitment. Second, the digital envelope should be binding, meaning with this that Participant cannot change his mind about \(m\), and by checking the opening of the commitment one can verify that the obtained value is actually the one Participant had in mind originally[12].

**Preliminaries**

a. A polynomial of degree \((u-1)\) \(f(x)= a_{u-1} x^{u-1} + \cdots + a_1 x + a_0 \mod p\) in the finite field \(GF(p)\) is chosen, where \(a_{u-1}, \ldots, a_1\) are random integers and \(a_0= SK\). Then, the key pieces \(S_{Ki} = f(d_i) \mod p\) can be calculated and delivered to each and every responding participant through secure channels.

b. \(u\) coordinates \((d_1,SK_1), (d_2,SK_2), \ldots, (d_u, SK_u)\) can be acquired through the cooperation from any \(u\) participants. According to Lagrange interpolation polynomial

\[
SK = f(0) = \sum_{i=1}^{u} S_{Ki} \prod_{j \neq i, j=1}^{u} \frac{d_j}{d_j - d_i} \mod p
\]

**Definition 1.** A metric space is a set \(C\) with a distance function

\[dist : C \times C \rightarrow R^+ = [0, \infty)\]

Which obeys the usual properties (symmetric, triangle inequalities, zero distance between equal points).

**Definition 2.** Let \(C\{0, 1\}^n\) be a code set which consists of a set of code words \(c_i\) of length \(n\). The distance metric between any two code words \(c_i\) and \(c_j\) in \(C\) is defined by

\[dist(c_i, c_j) = \left| c_i^r - c_j^r \right|, C_i, C_j \in C\]

This is known as Hamming distance [17].

**Definition 3.** An error correction function \(f\) for a code word \(c\) is defined as

\[f(c_i) = \{ c_j | \text{dist}(c_i, c_j) \text{ is minimum, over } C \{c_i\} \}\]

Here, \(c_j = f(c_i)\) is called the nearest neighbor of \(c_i\).

**Definition 4.** The measurement of nearness between two code words \(c\) and \(c'\) is defined by

\[\text{nearness}(c, c') = \frac{\text{dist}(c, c')}{n}, c, c' \in C\]

it is obvious that \(0 \leq \text{nearness}(c, c') \leq 1\).

**Definition 5.** The fuzzy membership function for a codeword \(c'\) to be equal to a given \(c\) is defined as [18]

\[Fuzz(c') = \begin{cases} 
0 & \text{if } \text{nearness}(c', c) = z \leq z_o < 1 \\
z & \text{Otherwise}
\end{cases}\]

from papers.

**Our Process**

a. A polynomial of degree \((u-1)\) \(f(x)= a_{u-1} x^{u-1} + \cdots + a_1 x + a_0 \mod p\) in the finite field \(GF(p)\) is chosen, where \(a_{u-1}, \ldots, a_1\) are random integers and \(a_0= SK\). Then, the key pieces \(S_{Ki} = f(d_i) \mod p\) can be calculated and delivered to each and every responding participant through secure channels.

b. \(u\) coordinates \((d_1,SK_1), (d_2,SK_2), \ldots, (d_u, SK_u)\) can be acquired through the cooperation from any \(u\) participants. According to Lagrange interpolation polynomial

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SK = f(0) = \sum_{i=1}^{u} S_{Ki} \prod_{j \neq i, j=1}^{u} \frac{d_j}{d_j - d_i} \mod p
\]

c. There are several disadvantages when traditional secret sharing is used in WMNs:

(a) If a dishonest participant may deliver an incorrect key piece or if there is anything wrong in data transmission, the correct secret key \(SK\) cannot be reconstructed

(b) If there is a malicious attacker among the \(n\) participants, it may deliberately deliver a fake key piece to other and, at the same time, receive all the correct key piece from others. Then, only it can reconstruct the correct secret key \(SK\) while others who receive a faked piece cannot

(c) In a wireless mobility environment, an attacker can attack a holder and break one key piece in a limited time and then move to attack all \(u\) holders and acquire the \(u\) key pieces so as to calculate the shared secret key \(SK\).

Let us consider the matrix equation of the form \(WUQ\) where \(W\) is a \((u \times u)\), \(U\) is \((u \times 1)\) and \(Q\) is a random \((1 \times 1)\) matrix.
The substance of the Lagrange interpolation polynomial is that there exist a unique feasible solution \( A \) in the matrix equation \( W \) and \( P_u \) are given. A necessary sufficient condition is that the rank of the augmented matrix is the same as that of \( W \) which is equal to \( u \), hereby marked as \( R(W) = u \).

a. If \( R(W) = u \) there is a unique solution for the equation, there is no fault/cheater is detected/existed follow the process (1).

b. If \( R(W) < u \) there are more than one solution for the equation warning bell is ringing so more parameter needs to be gathered until step 1.

Process (1)

Public Key: \( P_u = WUQ \)

Encryption: \( c = mP_u + e \)

Where \( m \) is a \( u \)-bit message, \( c \) is \( n \)-bit ciphertext, and \( e \) is an \( n \)-bit random error vector of weight \( a \).

Decryption: The receiver first calculates

\[
W = \begin{bmatrix}
    d_1^{u-1} & - & - & d_1 & 1 \\
    d_2^{u-1} & - & - & d_2 & 1 \\
    - & - & - & - & 1 \\
    - & - & - & - & 1 \\
    d_u^{u-1} & - & - & d_u & 1 \\
\end{bmatrix}
\]

\[
W = \begin{bmatrix}
    a_{u-1} & SK_1 \\
    a_{u-2} & SK_1 \\
    - & - \\
    - & - \\
    a_u & SK_u \\
\end{bmatrix}
\]

\[
U = \begin{bmatrix}
    a_{u-1} & SK_1 \\
    a_{u-2} & SK_1 \\
    - & - \\
    - & - \\
    a_u & SK_u \\
\end{bmatrix}
\]

\[
\overline{W} = \begin{bmatrix}
    d_1^{u-1} & - & - & d_1 & 1 & SK_1 \\
    d_2^{u-1} & - & - & d_2 & 1 & SK_1 \\
    - & - & - & - & 1 & - \\
    - & - & - & - & 1 & - \\
    d_u^{u-1} & - & - & d_u & 1 & SK_u \\
\end{bmatrix}
\]

Where \( Q^1 \) is the inverse of \( Q \). Because the weight of \( eQ^1 \) is the same as the weight of \( e \), the receiver uses the decoding algorithm of the original code \( T \) to obtain \( m' = mW \). Finally, the receiver recovers \( m \) by computing \( m = mW^1 \), where \( W^1 \) is the inverse of \( W \).

A tuple \( \{ P, H, M, f \} \) where \( M \subseteq \{0, 1\}^n \) is a message set which consider as a code, \( P \) is a set of individuals, generally with three elements A participant as the committing party, Robot as the party to which commitment is made and TC as the analysis wing of the Robot as trusted party, \( f \) is error correction function and \( H = \{a_i, i = 0, 1, 2\} \) are called the events occurring at times \( t_i \), \( i = 0, 1, 2 \), as per algorithm \( a_i \), \( i = 0, 1, 2 \). The scheme always culminates in either acceptance or rejection by A and B.

In the setup phase, the environment is setup initially and public commitment key \( CK \) generated, according to the algorithm setupalg \( (a_0) \) and published to the parties sender and robot at time \( t_0 \). During the commit phase, Participant commits to a message \( m \), \( M \) then robot finds \( g : m \rightarrow P_u(m) \)

Encryption: \( E = mP_u + e \), where \( m \) is the \( u \)-bit message, \( E \) is an \( u \)-bit cipher text and \( e \) is an \( n \)-bit random error vector of weight \( a \).

According to the algorithms committal into string \( c \) i.e. sender commitment

\[
c = \text{committalg}(\text{XOR}, g(m), E),
\]

Then after participant sends \( c \) to robot, which Robot will receive as \( t(c) \), where \( t \) is the transmission function which includes noise.

In the open phase, Participant sends the procedure for revealing the hidden commitment at time \( t_2 \) and robot use this.

So Participant discloses the procedure \( g(m) \) and \( E \) to robot to open the commitment.

openalg: Robot constructs \( c' \). using committalg, message \( t(m) \) and opening key

I.e.

\[
c' = \text{committalg}(\text{XOR}, t(g(m)), t(E))
\]

and checks whether the result is same as the received commitment \( t(c) \).

Then after acceptance, robot calculates \( f(c') (P_u)^{-1} \) and finally gets the message.

Decryption: The robot first calculates \( c' = \text{committalg}(CK, t(g(m)), t(E)) \), where \( t \) is the transmission function. The robot checks the \( \text{dist}(t(c), c') \neq 0 \), then apply Error Correction function \( f \) to \( c' \) and finds \( f(c') \). Then after apply

Fuzzy decision making:

\[
\text{If(nearness } (t(c), f(c')) \leq Z_0)\]

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24
Then sender is bound to act as in m
Else free not to act as m.

Then robot uses the decoding algorithm of the original code
T to obtain

\[ m' = m (P_u) \]

Finally, the robot recovers m by computing \( m = m' (P_u)^{-1} \),
where \((P_u)^{-1}\) is the inverse of \((P_u)\).

CONCLUSION

Our process has advantage that it is using for \((u-1)\)
independent variable, then form public/private key. It also
reduce noise introduced by the environment during the
transmission.

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Short BioData for the Athour

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